CLAIMS

What is claimed is:

1.   A circuit for measuring leakage current, said circuit comprising:

5   a pre-charge device subject to a first backbias voltage;

a leakage test device subject to a second backbias voltage, said leakage test device coupled to said pre-charge device, said leakage test device biased to an off state;

a differential amplifier coupled to said pre-charge device and said

10   leakage test device; and

a delay unit coupled to said differential amplifier and to an input of said pre-charge device; wherein said pre-charge device is turned on and off at a frequency that corresponds to said leakage current.

15   2.   The circuit of Claim 1 wherein said leakage current is a transistor leakage current.

3.   The circuit of Claim 1 wherein said leakage current is a gate leakage current.

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4.   The circuit of Claim 1 wherein said pre-charge device comprises a positive-channel metal-oxide semiconductor (PMOS) transistor and said leakage test device comprises a negative-channel metal-oxide semiconductor (NMOS) transistor.

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5.   The circuit of Claim 1 wherein said pre-charge device comprises an NMOS transistor and said leakage test device comprises a PMOS transistor.

6.   The circuit of Claim 1 further comprising a voltage generator for generating said first backbias voltage and said second backbias voltage.

5   7.   The circuit of Claim 1 wherein said first and second backbias voltages are controlled independently of each other.

8.   The circuit of Claim 1 wherein said first and second backbias voltages are different from each other.

10   9.   The circuit of Claim 8 wherein said first backbias voltage is equal to a supply voltage Vdd.

10.   The circuit of Claim 1 wherein said circuit comprises other devices

15   that are of the same type as said leakage test device, wherein said second backbias voltage and backbias voltages applied to said other devices are equal.

11.   The circuit of Claim 1 further comprising:

20   a test signal measurement unit coupled to said differential amplifier, wherein an output of said test signal measurement unit is used for calculating a value of leakage current.

12.   The circuit of Claim 11 further comprising:

25   a reference signal measurement unit;

a reference differential amplifier coupled to said reference signal measurement unit; and

a reference delay unit coupled to said reference differential amplifier, wherein an output of said reference signal measurement unit is used with said output of said test signal measurement unit to calculate said value of leakage current.

13. A circuit for measuring leakage current, said circuit comprising:

a pre-charge device subject to a first backbias voltage, said pre-charge device coupled to a first node;

a leakage test device subject to a second backbias voltage, said leakage test device also coupled to said first node, said leakage test device biased to an off state but having a leakage current; and

a differential amplifier coupled to said first node and to a second node that is coupled to an input of said pre-charge device; wherein said pre-charge device is turned on to drive said first node to a voltage not equal to a reference voltage, wherein said pre-charge device is then turned off; wherein said leakage current brings said first node to said reference voltage, driving said second node to a high value that turns said pre-charge device on again; and wherein said pre-charge device is turned on and off at a frequency that is proportional to said leakage current.

14. The circuit of Claim 13 wherein said leakage current is a transistor leakage current.

15. The circuit of Claim 13 wherein said leakage current is a gate leakage current.

16.   The circuit of Claim 13 wherein said pre-charge device comprises a positive-channel metal-oxide semiconductor (PMOS) transistor and said leakage test device comprises a negative-channel metal-oxide semiconductor (NMOS) transistor.

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17.   The circuit of Claim 13 wherein said pre-charge device comprises an NMOS transistor and said leakage test device comprises a PMOS transistor.

18.   The circuit of Claim 13 further comprising a voltage generator for

10   generating said first backbias voltage and said second backbias voltage.

19.   The circuit of Claim 13 wherein said first and second backbias voltages are controlled independently of each other.

15   20.   The circuit of Claim 13 wherein said first and second backbias voltages are different from each other.

21.   The circuit of Claim 20 wherein said first backbias voltage is equal to a supply voltage Vdd.

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22.   The circuit of Claim 13 wherein said circuit comprises other devices that are of the same type as said leakage test device, wherein said second backbias voltage and backbias voltages applied to said other devices are equal.

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23.   The circuit of Claim 13 further comprising:

a test signal measurement unit coupled to said differential amplifier,

wherein an output of said test signal measurement unit is used for calculating a

value of leakage current.

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24.   The circuit of Claim 23 further comprising:

a reference signal measurement unit;

a reference differential amplifier coupled to said reference signal

measurement unit; and

10   a reference delay unit coupled to said reference differential amplifier,

wherein an output of said reference signal measurement unit is used with said

output of said test signal measurement unit to calculate said value of leakage

current.

15   25.   The circuit of Claim 13 wherein said first node is driven to greater

than said reference voltage, wherein said leakage current reduces said first

node to said reference voltage.

26.   The circuit of Claim 13 wherein said first node is driven to less

20   than said reference voltage, wherein said leakage current raises said first node

to said reference voltage.

27.   A method for measuring leakage current, said method comprising:

driving a circuit comprising a pre-charge device, a leakage test device

25   and a differential amplifier, wherein said pre-charge device is subject to a first

backbias voltage and said leakage test device is subject to a second backbias

voltage, said leakage test device biased to an off state and having a leakage

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current, wherein said leakage test device and said pre-charge device are coupled to a first node and wherein said differential amplifier is coupled to said first node and to a second node that is coupled to an input of said pre-charge device;

5   extracting a first test signal from said circuit, said first test signal having a first frequency; and

         estimating said leakage current from said first frequency.

28.   The method of Claim 27 wherein said driving further comprises:

10   turning on said pre-charge device to drive said first node to greater than a reference voltage, turning off said pre-charge device; and

         reducing said first node to said reference voltage as a result of said leakage current, wherein said second node is driven to a high value that turns on said pre-charge device again;

15   wherein said first test signal is generated from said turning on and said turning off of said pre-charge device, said first frequency corresponding to the frequency at which said pre-charge device is turned on and off.

29.   The method of Claim 27 wherein said driving further comprises:

20   turning on said pre-charge device to drive said first node to less than a reference voltage, turning off said pre-charge device; and

         raising said first node to said reference voltage as a result of said leakage current, wherein said second node is driven to a high value that turns on said pre-charge device again;

25   wherein said first test signal is generated from said turning on and said turning off of said pre-charge device, said first frequency corresponding to the frequency at which said pre-charge device is turned on and off.

30.   The method of Claim 27 wherein said first and second backbias voltages are controlled independently of each other.

5   31.   The method of Claim 27 wherein said first and second backbias voltages are different from each other.

32.   The method of Claim 31 wherein said first backbias voltage is equal to a supply voltage Vdd.

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33.   The method of Claim 27 wherein said circuit comprises other devices that are of the same type as said leakage test device, wherein said second backbias voltage and backbias voltages applied to said other devices are equal.

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34.   The method of Claim 27 further comprising:

driving a reference circuit in parallel to said driving of said circuit, wherein said reference circuit is isolated from said pre-charge device and said leakage test device;

20   extracting a second test signal from said reference circuit, said second test signal having a second frequency; and

using said second frequency in said estimating of said leakage current.